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What happened? What can we do about that?
Analysing the costs/benefit balance of patient handling incidents:
an ergonomist's systematic view.

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“The management of accidents was neglected as a professional strategy until into the twentieth century in part because they happened to the labouring classes and (unlike infectious disease) did not threaten the health of the wealthy or influential.”
Green (1977)

“A cynic is a man who knows the price of everything but the value of nothing”
Oscar Wilde

Introduction – the incident

It is nearing the end of the shift and a patient needs to be transferred to a bath. Two nurses manoeuvre a hoist to the bedside, adjust the sling and lift the patient clear of the bed. One of the nurses is called away and the other adjusts the sling. She talks with the patient. Satisfied that all is in order she swings round and reaches down to pull the hoist and as it shudders she screams. Subsequent investigations indicate a back injury and the nurse begins, what becomes, a month away from work. In this case an, apparently, full recovery is made.

The incident investigation might ask questions about the orientation of the castors and whether or not they were aligned with the direction in which the hoist was to be moved, the congestion caused by adjacent beds and furniture. The investigator would be expected to ask about the training that the nurse had been given and why she twisted and reached backwards as she sought to start the hoist moving. They might also ask about the maintenance programme, whether the castors were moving freely and the co-efficient of friction between floor and footwear. Fellow Ward staff might send a *get-well-soon* card and the Trust might send flowers but who will talk with the family of the injured nurse or the patient and his family about the incident.

The Trust might request a report outlining the cost of the incident and whether, or not, any similar events have happened before. They might be told about any risk of a Health and Safety legislative violation that could lead to prosecution (criminal or civil) and they might hear from a Union or Professional body's representative. The local paper might call the press office but would anybody inform the manufacturer or the designer of the hoist; unless they were to be part of a legal action?

Are hospitals like businesses? Managing the financial perspective.

Following an incident organisations quickly focus on financial matters. The direct costs may be quick and easy to quantify but the consequential costs less so.

When running a commercial business the fundamental aim, indeed the legal imperative, is to maximise shareholder wealth. Of course there are other requirements; to trade legally and safely, for example, but it is the requirement for the plc to create the wealth that should underpin its activities and decision-making albeit with regard to the time over which the accumulation of wealth should be considered.

Wealth includes notions of spiritual well being but is, in this context, “A collective term for those things the abundant possession of which (by a person or a community) constitutes riches, or ‘wealth’ in the popular sense.” (OED 2002) The OED also identifies, a 1848 quote as the most commonly accepted by economists.

“Money, being the instrument of an important public and private purpose, is rightly regarded as wealth; but everything else which serves any human purpose, and which nature does not afford gratuitously, is wealth also.... Wealth, then, may be defined, all useful or agreeable things which possess exchangeable value; or in other words, all useful or agreeable things except those which can be obtained, in the quantity desired, without labour or sacrifice.” (OED 2002)

Thus for a conventional “profit making” business wealth is a vector quantity. If the analogy of a balance is adopted then the revenue (hopefully the profitable) end of the beam should drop down raising the other end until balance is restored by the imposition of the shareholder dividend to the expenditure.

You might, for example feel “had” if you realised the extent to which your “weekly shop” contributes to a plc’s profits and the generous shareholder dividends it pays. However, there is little you can do alone and it may not be until vast numbers of shoppers change their behaviour that the business will react. Simply, for a “well regarded” plc the shareholder wealth flows from the unfettered sales of product and services from which revenue is directly generated.

A business operating in a highly regulated market is not free to trade and to maximise shareholder wealth as it might wish. The privatised utilities¹, for example, fall into this category as they are not free to strive, without constraint, to maximise the wealth of their shareholders. The Government seeks to regulate these businesses and to balance their freedom to operate with a “public service” imperative that continues from their past ownership.

The community may also hold this view and still (emotionally at least) regards them as offering a commodity that is a right for all. Few would suggest that a supermarket should supply those who cannot (or will not pay) but they may hold a different perspective if an elderly person has their electricity disconnected or must wait for hours on a trolley, looking up at the ceiling, while an empty bed, in an suitable ward, is found.

The “not-for-profit” or charity business is another sector regulated (or constrained) by Government. In the case of the “Registered Charity” this monitoring and regulation is carried out by the Charity Commissioners who, for example, seek to limit, on behalf of the community, the proportion of a donation that goes on administration, fund raising or is placed into *reserves*.

Included in this category are the organisations that are still regarded by many as being in the public sector. The administrators running these *Agency* businesses must spend (prudently) the funds, raised in taxes, and allocated by the Government. These people have a difficult balancing act to follow. Not only must they ensure that the scales of income/grant and expenditure/spend balance but they must strive to ensure that the income is sufficient for the work they wish to undertake. Spending too little so that a surplus is created can be as problematic as spending too much.

¹ The Government also, seeks to regulate other “essential” and near “monopolistic” business sectors (banking, insurance, etc) but this is beyond the scope of this paper.

There is also the “public service” aspect that must be considered. A shortage of capacity to undertake a medical operation or any suggestion that a new drug might not be made immediately available to all can be the subject of howls of media attention in a way that a supermarket not having the oven cleaner advertised on TV cannot ever be. The clear vector or tipped scales of the plc are replaced in the public sector by a need for a precision balance of restricted funds. For such organisations the ability to quantify accurately the un-quantifiable cost of an incident is important! Furthermore, while the turnover of the plc is limited by what it can earn from the competitive environment in which it operates, borrow or persuade others to invest the fundamental funding of the public sector appears simpler – it can only spend what it has been given! For the public sector costs must be such organisations

The funds allocated (“grants”) will be politically sensitive; Governments too have tipping points that can be politically sensitive, especially when election must be won. In recent years the desire to reduce the money taken from the population as taxes has seen to need reducing and thus the funds available for distribution must also reduce. (To add another layer to the complexity consider the desire of a Government not to raise money by selling long term bonds. This, not only reduces what is available but also increases the costs of pensions as the long term minimal risk investments sought are also not available. This, in turn, can increase the cost of pensions, the volatility of the labour force and thus the organisational benefits/dis-benefits associated with labour turnover.

The public sector administrator seeking to balance their accounts and, probably, to obtain this balance at a level below that which they would wish for must find ways to reduce expenditure. This will also be the government’s desire as they seek to reduce the public sector proportion of GDP.

Services might be *out-sourced*; cleaning, catering and car pools might now be run by plc businesses who must not only provide the service specified but also generate their shareholder dividend. (This redistribution of the workforce has many effects; one emergent property can be that the apparent risk to health of working for the organisation changes. If the staff transferred work in a low risk area, secretarial perhaps, then the number of *accidents* recorded does not drop but number of people exposed does. The reverse is, obviously true, if it is a higher risk role, eg Porterage, that is *out-sourced*.)

The direct allocation of services, perhaps the provision of medical operations by a private hospital or the creation of facilities funded by schemes such as PFI and PPP are alternative ways reducing the turnover but, hopefully, not the activity. While these schemes are highly regulated they will, contentiously, result in a proportion of allocated funds leaving the by public sector and appearing as “shareholder wealth”.

The argument goes that the plc business is more efficient and this might be so. But, it has a much easier requirement to fulfil; not of balance but of maximisation. There is also the question of time-scale.

A public sector organisation building up reserves to fund a big purchase will be open to criticism simply for not spending the monies allocated immediately. Time is a factor that the plc business can employ. If the business is prepared to take a longer view then the strategy could be to gain market share first and only later raise prices and reap profits. (You may remember the British motorcycle industry and how it lost out to low priced Japanese bikes. In the short term the price quoted was enticing but Japanese bikes have ceased to be cheap. However, the British bike is no longer produced in numbers nor is the infrastructure, for mass production, in existence.)

Another aspect which is often the source of comment in the media is risk management. The argument goes that the transfer of risk saves the public sector resources but is this so? This is true for a case of food poisoning from a, now private, canteen but might not be so for larger, catastrophic, risks.

For 350 years since Lloyd opened his coffee shop the concept of insurance has shared risk but in recent years this has not been without limit. One hundred and forty four years ago the Great Companies Act (1862) was passed and the limited company format created² to ensure just that; liability was limited! Consider this scenario. Under the *patient choice* strategy a boycott of a particular pfi funded hospital is applied. Is it conceivable that this will bring down the business? Perhaps the regulations will be changed or the hospital converted to Offices but it is highly unlikely that the business itself will fail. [A subsidiary might but then one of the reason for creating subsidiaries is to insulate the *group* from the failure of a component.]

Now so far this session must seem like a strange perspective for an ergonomist to take but ergonomics has always struggled with the notions of health and wellbeing and the business benefit (enhanced profits) that will be created to make the specified improvements pay. Waterson and Sell (2006) quote Rodger's (1959) report of the Ergonomics Society's Oxford Annual Conference referring to the disagreement between Workstudy Engineers and Ergonomist at the first conference in 1959. Twenty five years later this was still an issue and shortly after graduating with my Ergonomics MSc I found myself on a Methods-Time- Measurement course. The training in observation has prove invaluable, the classification scheme useful but the predetermined times have little to recommend them as those who know Charlie Chaplain's Modern Times may recognise.

Who knows what? Who's kept informed?

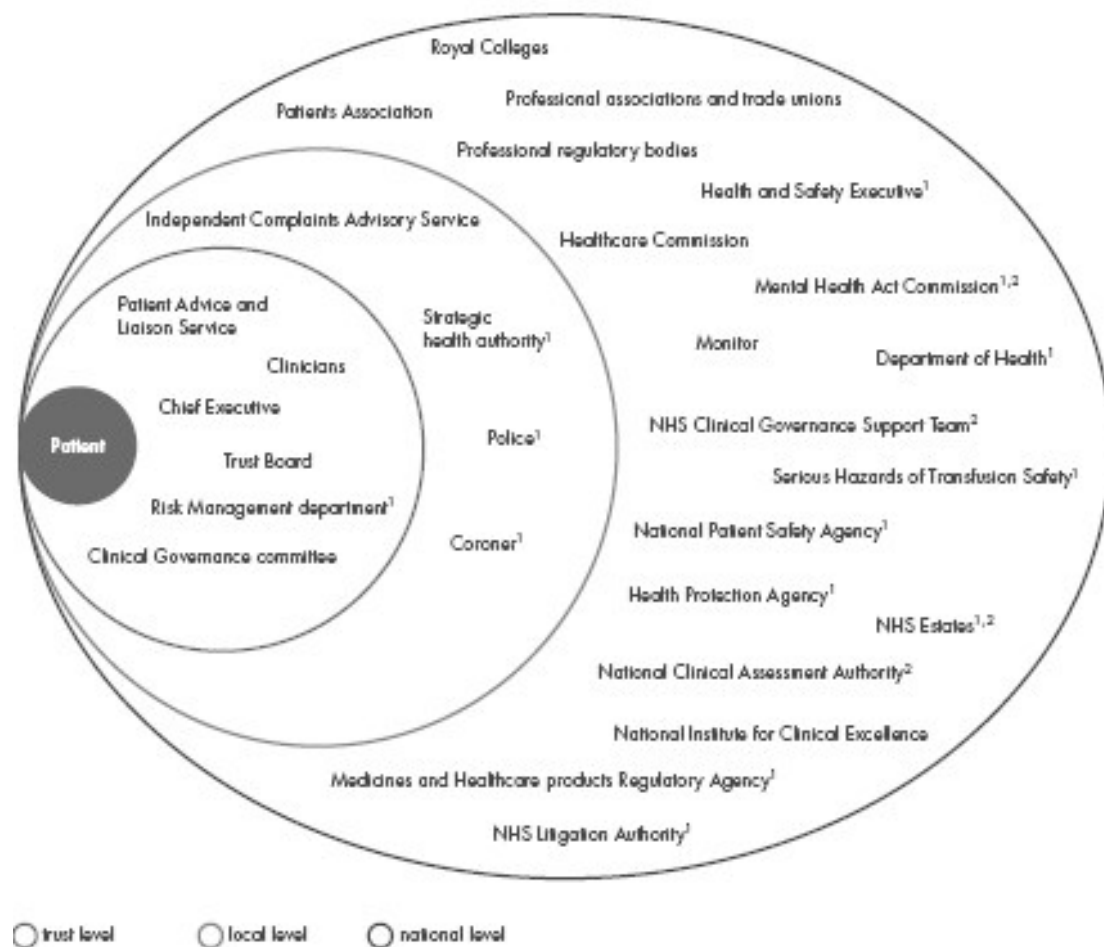
In 2005 the National Audit Office (NAO 2005) published the results, from a patient/Department of Health perspective, of a major study into the costs of patient safety and how these might drive improvements. The model underpinning their work is reproduced as figure 1 (overleaf).

However, it focuses on the formal established, *hard data* rather than the *softer* human aspects of the undesirable incident. Family, friends and community, for example, are not included in the NAO model³. These people, but especially those involved are represented by organisations rather than including themselves. Nor does it directly consider the architects, designers and manufactures of the equipment, furniture and workspaces that contributed, to a greater or lesser degree, in the incident.

It should also be noted that the 1998 Human Rights Act gives a legal strength to the consideration of these softer issues and provides a mechanism for the resolution of conflict and allocation of quantifiable costs. For example the case of Lorraine Wolsternholm included reference to this legislation as well as conventional "judicial review" of a decision made by a public body/servant. The case included the comment by "Mr Justice Ouseley that: 'I do find it quite extraordinary that no means can be devised for lifting an eight-and-a-half stone woman once a day safely, or reasonably safely.'" (BBC 2003a) Liberty publish a guide to this legislation (2005).

² This was the for-runner of the plc. It is argued by Micklethwait and Wooldridge (2003) that this was one of the most significant enabling creations of the Victorian era.

³ Note that James Reason is listed as a member of the Expert Advisory Panel for the project.



1. Organisations to which a patient safety incident will be reported either on a voluntary or statutory basis.
2. Following the Department of Health's review of Arm's Length Bodies, the functions of these organisations have been or are in the process of being transferred to other bodies.

Figure 1.
The NAO's stakeholders in patient safety model [NAO (2005)]

How many and at what cost?

Patient Injury due to "falls" was found to be the most frequent injury type (31.5%) with "medication errors" (7.1%) the next most frequent. "Equipment related" (4.1%) was the next most frequent.

The summary reports a retrospective study of two "hospitals found 10.8% of all patients experienced an adverse incident of which around half (5.2%) were judged to be preventable." However, in 2003/4 885,832 patient safety incidents/near misses were reported; a number that rose, the following year, to 974,000. The NHS treats over a million people daily which would imply that only c2.5% of incidents are reported. The potential avoidable costs are estimated as c1 billion annually⁴ (NAO 2005) but without precise data a public sector organisation will find it hard to manage the financial environment and ensure its accounts balance.

⁴ Note that all the data in this discussion excludes hospital acquired infections which may cost a further 1 billion annually.

The cost of lifting and handling *accidents* within health care have been frequently investigated. Ten years ago Leamon and Murphy (1995) reported that “materials handling” claims in the Health Care Sector represent 52% of all claims but that these are worth 62% by value. A three year long Canadian study (Chhokar et al 2005) described a cost/benefit justified community installation of ceiling lifts to transfer patients. The number of total claims, made by the healthcare worker for injury (primarily musculoskeletal injury) drops by nearly 1/3 (65/47) over similar periods of time and a payback period of 2.50 years was obtained. Annual savings of C\$238,166 (£129,000)⁵ were obtained against the initial investment of C\$344,323 (£186,500) (but if the assumption was made that the claims for damages would continue to grow then the payback period drops to 0.82 years (less than 10 months).

In the UK several closely cost studies have undertaken and reported; for example, Wigan and Leigh NHS Trust, Nottingham City Hospital and the Kings Health Care NHS Trusts. (HSE (2001), Fazel (1998), Tracy 1998)).

The Department of Health “Back in Work Campaign” (DOH 2001) included the estimate that manual handling related sickness cost the NHS £400M per year and that each employee who retires early because of a back injury “cost the NHS at least an extra £60,000.” The statistic that “four out of five people” experience backpain during their working lives was also quoted.

These are the direct costs and probably don’t take into account the costs of any fine imposed for a legislative breach – perhaps the simple “failure to provide a safe working environment”. The management time associated with any legal action can also be extensive and, largely, uncontrollable. Two examples, which both of which took several years to be resolved, may illustrate the magnitude of these issues.

- In October 2002 a Mrs Angela Knott was awarded £420,000 after it was found that she had injured her back in 1998 while lifting patients within Newham General Hospital. Insufficient hoists had been provided. (BBC 2002 & 2003b)
- Karl Douglas, an ICU nurse, obtained a higher settlement from Greenwich Health Authority - £803,515.08. Again the lack of suitable hoists was regarded as significant. (Anon 2000)

The financial cost of incidents, including those related to patient handling or moving is readily quantified but such feedback is difficult to apply to the feedforward, creative, process of the designer.

Reason’s (1994) systemic approach to organisational error focuses upon people and behaviour in response to the task and equipment require. Three classes of errors are identified.

- 1 *Skill-based errors*
- 2 *Rule-based mistakes*
- 3 *Knowledge-based mistakes*

For incidents involving equipment the classification must be expanded to include its design and operation. Training and behaviour change alone are not significant to minimise the risk.

⁵ Converted to mid 2006 with one Canadian dollar(C\$) at c52p and inflation at 4% (1/07/06)

The un-quantifiable but significant “softer” costs.

The softer, emotive costs of an *accident* or other undesirable incident should be considered together with the relatively easily quantifiable direct costs. Figure 2. (below) shows the soft/hard costs of an incident as a matrix.

The emotive, horizontal, axis will influence the Corporate Image and thus impact upon the marketing of the organisation’s services, recruitment and retention of staff while the actual consequences will impact directly upon costs, financial viability and thus, again, marketing considerations. The emotive costs of an incident may also influence the local community from which the organisation may wish to recruit and from which the patients/clients/customers will often come (Porter 1995). Thus a “focused” strategy is indicated and the features underlying the incident must be understood.

Number and severity of injuries per event (incident/accident)	high numbers/ severe injuries (death(s))	<i>Major Accident/ Catastrophe</i> (eg virtually any major accident not involving (many) UK citizens or organisations!). (Eg Manila stadium stampede, BBC 2006)	<i>Catastrophic failure with significant impact</i> (eg BA aircraft crash, UK chemical plant explosion, mass medical infection/ incidents) (Eg tsunami, BBC 2004)
	low numbers/ slight injuries	<i>“Counted” Accidents, events that just keep on happening</i> (eg road accidents, slipping/tripping accidents, musculoskeletal injuries and <i>Asset only</i> incidents, near misses) (Seniors falling, Sun-Sentinel 2006)	<i>“Hypeable” Accidents</i> (eg minor road accident involving Royalty, rock stars, “chemicals” or nuclear fuel, Incidents with babies and war veterans. (Eg Princess Margaret, BBC 1999)
		low emotive incidents/ little engagement	highly emotive incidents or accidents/ high degree of concern
Emotive rating (“newsworthiness”!) (eg Semir 1996)			

Figure 2.

“Hard” (severity) v “Soft” (emotive) classification of *accidents*. (After Porter 1994)

Most hazards, thankfully, never become incidents and even fewer are recorded as *accidents* which injure or kill people. However, these unwanted and undesirable events will happen and the risk should be, as far as possible, estimated and managed. It is, however, easier for organisations to cost what has happened than it is to predict the cost of future failures/shortfalls. The “hard” financial issues will, usually be easier to quantify and contain than the “softer” aspects of the situation which can produce longer term, difficult to value repercussions.

New Product Development

New product creation is an area of activity in which ergonomics could make a contribution but where it has often failed to justify the benefits possible from the intervention. In marketing attention is often drawn to the real and perceived “good” ergonomics of the artefact. However, this use of the term is often questioned by ergonomists, not least because the marketing statement, generally, refers to only limited aspects of the product which may also include some ergonomically problematic design features too. A patient hoist, described as “ergonomically designed” might have good handles to hold and slings which will take people from 40kg to 240Kg but an ambiguous, counter intuitive, raise/lower control which often results in errors. It is only ergonomically good “in parts”.

In the 1920s/30s pioneering Industrial Designers such as Raymond Loewy (Schönberger 1991) and Henry Dreyfus would work, in an essentially linear path. They often devalued the user and the user’s perspective replacing this with an application of their own intuition/nous. Their excitement of applying technology to life was summed up in the slogan for the 1936 Chicago World’s Fair - *Science Finds, Industry Applies, Man Conforms*.

The foundations of ergonomics can easily be traced back to Bernardino Ramazzini (1633 – 1714) but it was not until the 1940s that the various strands coalesced and the modern disciplines of Ergonomics (UK) and Human Factors (US) created. At this time the focus was on research rather than the application of that research.

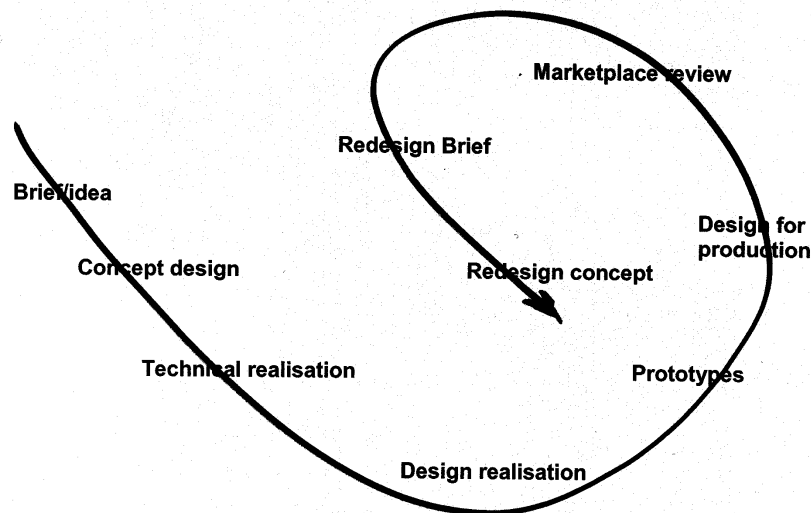


Figure 3.

A traditional, helical view of product development/engineering design. The pace of activity provides time for a considered ergonomic perspective and evaluation within the design process. (Porter 2005)

Forty years later the Designers started to see the benefit that might be gained from applying a user perspective to their work. The Ergonomics Research Society was approached to see if they would identify ergonomists who could help designers but the “Society did not feel that it could undertake the task”. (Waterson & Sell 2006).

Today working with designers is an emergent role for the ergonomist and many of the most successful creative groups employ such Human Factors specialist in similar numbers to they employ *creatives*. The ergonomists who have adapted to working within design teams/groups must adopt the *select and specialise* role of the *expert*

and the wider *General Practitioner* role. These ergonomists will recognise themselves as the “T” shaped individuals (Kelley and Littman 2005) who work well within IDEO and other creative design teams. These “T” ergonomists are often the first contact for others seeking help and they then *treat* or *refer*, as appropriate. They are successful because *they know what they don’t know and also who knows what they need to know!*

In the investigation of *accidents* the lessons learnt about the design of the product must be fed back into the design process so that better products are designed and produced. This feedback may be undertaken by, for example, “T” physiotherapists or by those ergonomists working and in the health care or hospital sector. However, these individuals must also be happy to work within the predictive, creative design process. This is a growing area of activity (Figure 4 below).

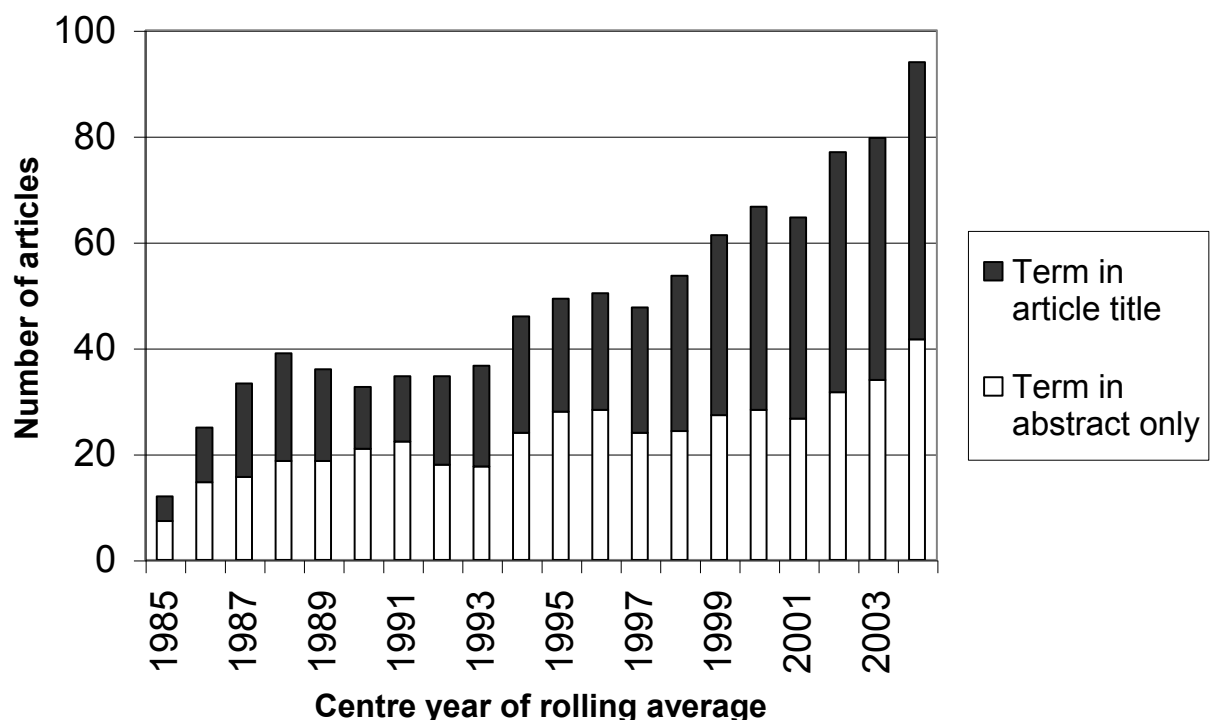


Figure 4.
Rolling three-year averages of the terms *nurse*, *nurses* and *nursing* (but excluding *nursery*) in articles “captured” by Ergonomic abstract.

However, these articles report the evaluation of situations, behaviours and artefacts but rarely make the applicable design recommendations sought by the Product or Industrial Designer working on the creation of new lifting and handling aids.

The Design process has also evolved. To cope with the increase in complexity of the designed world and the drive for the minimisation of the time from idea to marketplace various “lean design” and “rapid prototyping” strategies have been developed and employed.

The helical (*linear*) mode of product development, where brief/idea leads to concept and thence to technical realisation, design realisation, prototypes, design for production, marketplace review and redesign has been replaced by an organic

systemic team based approach. The ergonomist is now incorporated within the creative team. They still provide basic Human Factors data, conduct the experiments, field trials, *Hall Tests*, etc that are required to validate the concept, prototype and the final, *shipped*, design but no longer are they just adjacent to, the design process and called in “as and when” a need has been identified.

The linear design process first became more iterative and interconnected (figure 5.) and then fused into a multi-perspective, complex, systemically structured, integrated design process (Porter 1996) shown in Figure 6.

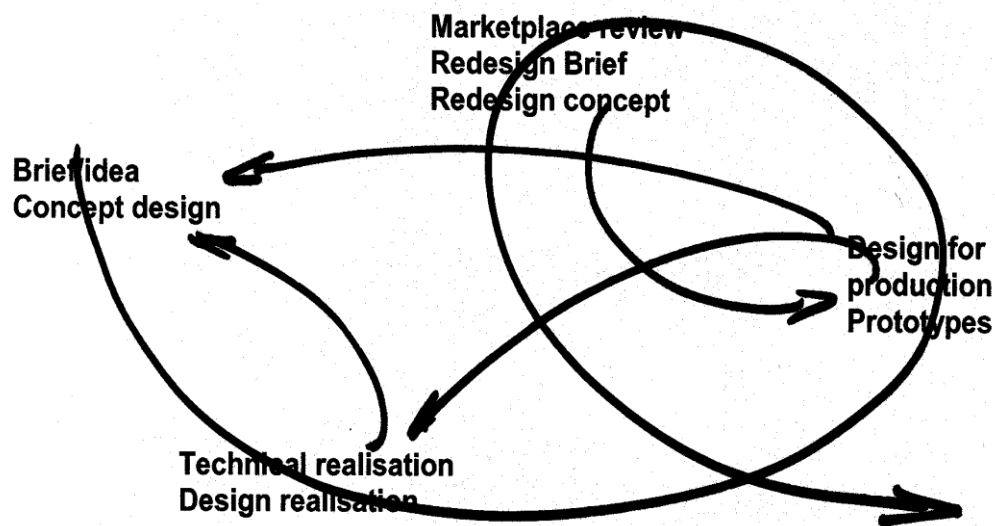


Figure 5.
A current perspective of the “lean”, “team based” product development process.
(Porter 2005)

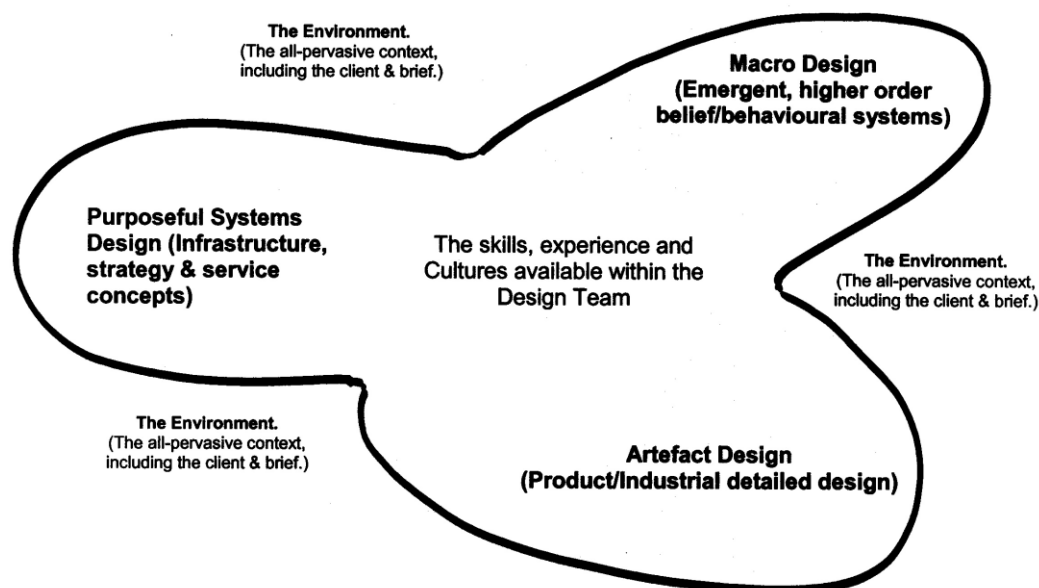


Figure 6.
A design paradigm in which the creative process covers the artefact, the systems that engage with it and its impact upon culture and behaviour. (Porter 2005)

It should be noted that much of this re-formulation of the design process has been driven by a desire to speed the process and that if care is not taken the final artefact is found, immediately upon launch, to be in need of revision. The opportunities for review and reflection in the traditional process can be lost from the new paradigm.

The role of the designer has also expanded and become an integrated studio team. The team is now less focused upon the artefact alone but also seeks to consider it in the context of the systems and the behavioural/cultural environment in which it will be used. The designer might, for example, create a hoist with reference to the types of bath and shower to be found in hospitals and the space available to manoeuvre within the ward. The discrete roles underpinning the product development model will now be integrated but will still need inputs from knowledgeable users. Ironically, it is the users who have had an inappropriate, unfortunate or undesirable experience, with an existing product, that are of most use to the creative process.

In an ideal world the primary users (patient, nurse, care worker, etc) of the hoist should engage directly with the design team but an effective alternative might be an informed ergonomist. What ergonomists can, and should do, during their engagement with the Design team is to specify the desirable usability and how that might be tested (Porter 1996). Working with the design team, and especially those responsible for the marketing, they should ensure that the brief contains targets that are responsive to the benefits that might be gained from an input of user centred ergonomics into the product and its subsequent positioning within the competitive environment.

Conclusions

- When undesirable incidents occur they must be investigated systematically with the intention of resolving the causes and minimising the consequences. The primary focus should be on the soft, not the financial issues and the analysis must be kept separate from the legal or disciplinary processes
- When investigating such *accidents* it must be appreciated that the direct and indirect costs (financial, social and community) will be far greater than is, in the first instance, readily apparent or quantifiable
- The ability of the public sector to balance accounts is, inherently, more demanding than the plc's imperative to maximise wealth
- It must be recognised that cost/benefit analysis mixes feedback with feed-forward control and that both will be required. Designers, architects, design engineers prefer, predictive, feed-forward control and accept that errors will be made that necessitate modification or reworking
- Change may not be rapid or readily *installed* especially when the behaviour of individuals or the creation and implementation of new equipment is required
- The creative process must be founded in the needs of the user before the requirements of the client are considered. Getting the former right should ensure the satisfaction of the latter
- Ergonomists and others with relevant understanding must contribute to the design process from the beginning and not confine themselves to the evaluation
- Health workers, or ergonomists working in the health care sector must adopt a predictive role to support the design of effective artefacts/workplaces/systems
- Architects, designers and design engineers will be part of the solution to any undesirable incident as human behaviour, alone, will not be the cause
- To work with these creative groups there is a need for "nurse ergonomists", "physio-ergonomists" or "T" skilled ergonomists with a depth in health care and a breadth in ergonomics who are happy with the predictive, initiative design process.

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